The Future of Transportation:
Connecting the Dots

Shelley Row, PE, CSP
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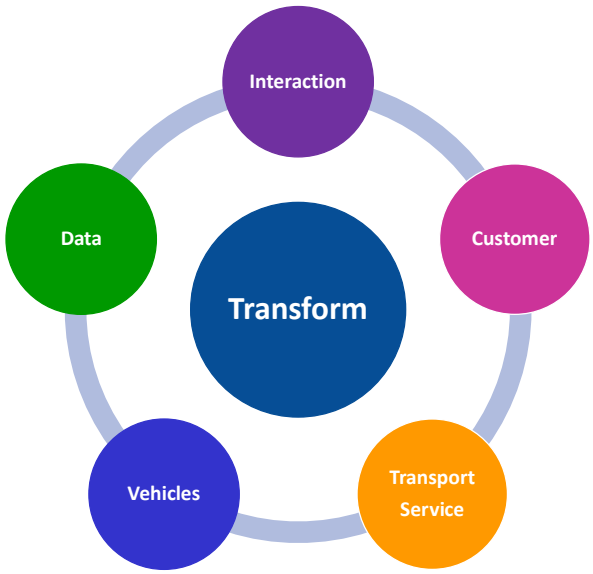
Transformation of Transportation



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Customer

Customer

Who are you planning for?

More than **50%** of all people who ever turned **80** are still alive today

55+ year-old workers in the American workforce

16.8% in 2006

22.4% in 2016

24.8% by 2026

1 in **4** American workers*

*Special Committee on the Aging 12/17

3

Customer

Customer

Who are you planning for?

Digital natives

2.7 billion smartphone users worldwide

65-80 notifications per day*

Average user touches their phone **2,617** per day*

82% of teenagers use a smartphone#

Gig Economy

70% of world's workforce may be "on demand" by 2025

* Washington Post, 6/18/18
#Digital Trends, 4/10/18

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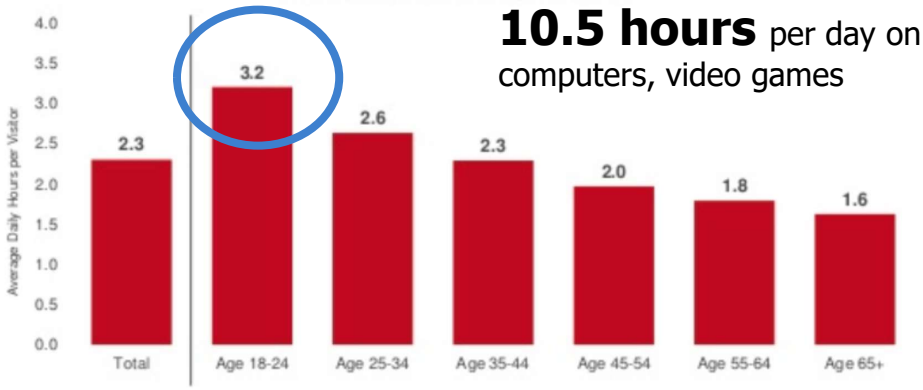
Customer

Customer

Who are you planning for?

2.25 hours per day on apps for average user*

58 min per day on Facebook at 10-12 min each time



10.5 hours per day on phones, TV, radio, computers, video games

* BuildFire, 2019

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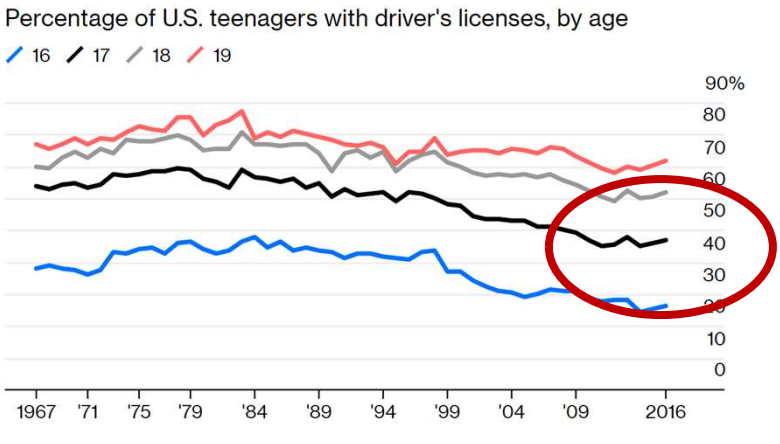
Customer

Customer

Who are you planning for?



Sources: Federal Highway Administration, Census Bureau

40% of 17 year-old's have a driver's license#

Population adjusted vehicle miles traveled are at **2002** level*

*Advisor Perspectives 7/19
#Bloomsberg Opinion 1/10/19

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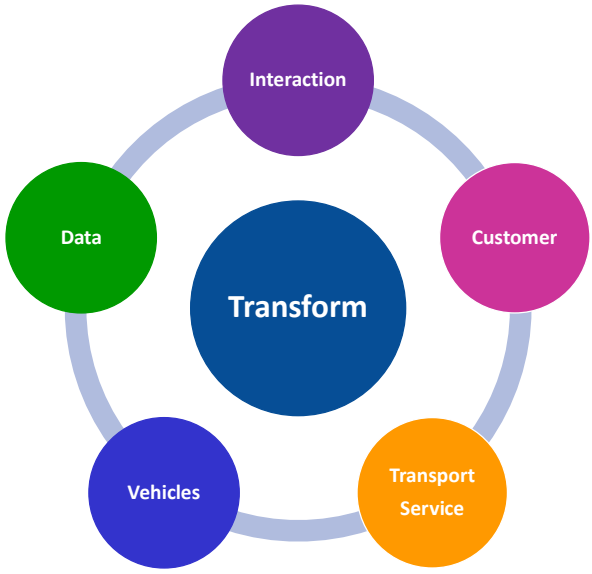

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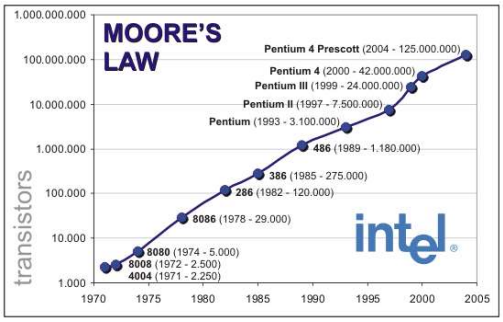
Interaction

Interaction

From connection to interaction

Moore's Law

Moore's Law states that the number of transistors that can be placed on an integrated circuit for the same price will increase exponentially by a factor of 2 every 18 to 24 months.



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Interaction

Interaction

From connection to interaction

80% of the world's population have mobile phones

Mobile traffic was **52%** of Internet traffic in 2018

*Statista.com 3rd Quarter 2018

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Interaction

Interaction

From connection to interaction

95 million photos and videos are shared on Instagram daily

People are **80%** more likely to read content with colored visuals

6 of 10 people prefer online video platforms to TV

Every minute **350,000** updates are sent to Twitter

10

Interaction

Interaction

From connection to interaction

2.23 billion monthly active users worldwide

88% are mobile users*

510,000 comments are posted every minute

5 new profiles are created every second

Every day **300,000,000** photos are uploaded to Facebook

*Hootsuite 11/13/18

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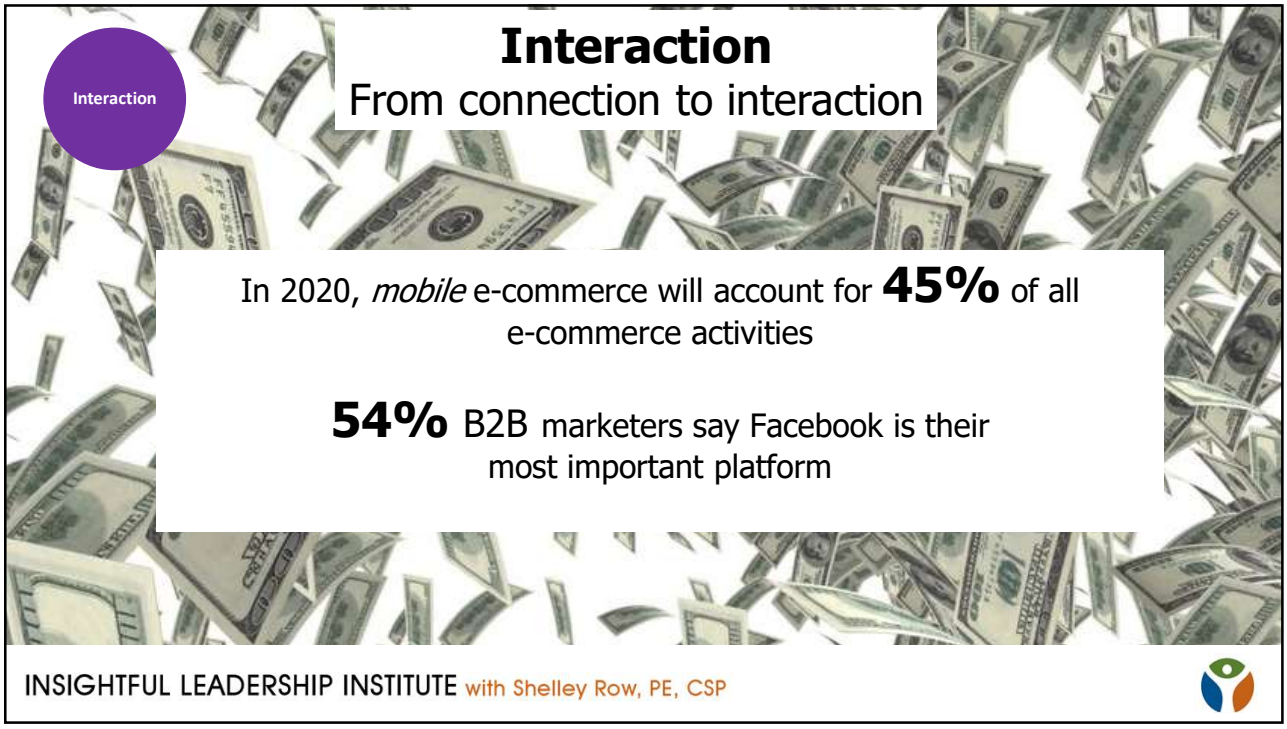

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Interaction

2008: Airbedandbreakfast.com launched

6,000,000 new guests in 2013
Nearly 250,000 properties were added in 2013

March 2015: Airbnb had funding that places it at
$20 billion valuation

It has over **1,000,000 listings** in **34,000 cities**
and **190 countries**

HILTON WORLDWIDE

750,000 rooms in 94 countries since its founding in **1919**

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Pope John Paul II, **April 2005**

Pope Francis, **March 2013**

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Interaction

Interaction

From connection to interaction

Assume everyone can **comment** on or **photograph** everything you do

62% used social media to report service issues

30% of customers expect a response within 1 hour

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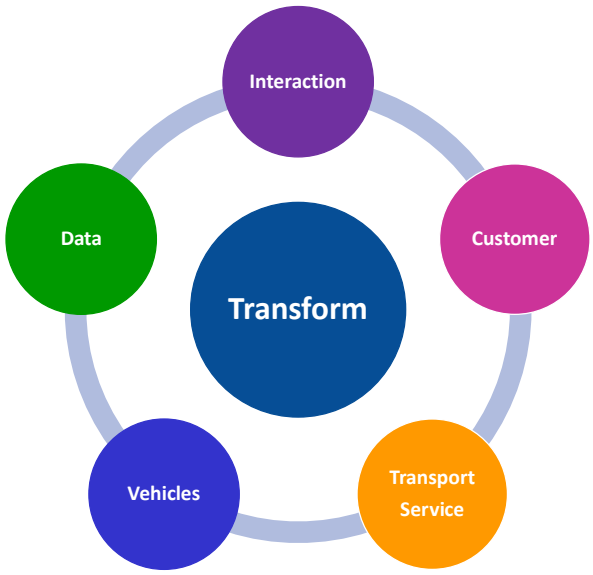

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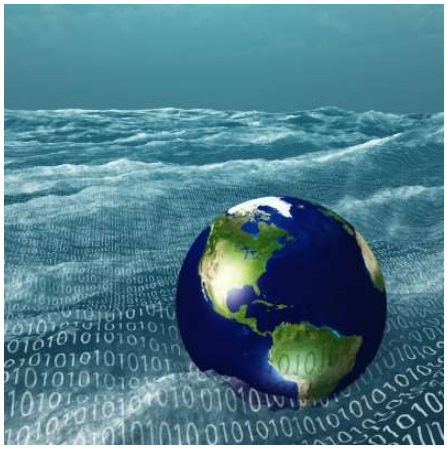
Data

Data
Data to Information



20 households generate more internet traffic as the entire internet in 2008

*Statista.com 3rd Quarter 2018

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Data

Data
Data to Information

Big data analytics market is projected to be
$275 billion
as of 2023*

If all connected vehicles with the ability to capture data were monetized, the opportunity would be
$33 billion by 2025**

*Market Watch 8/27/18
**Frost & Sullivan

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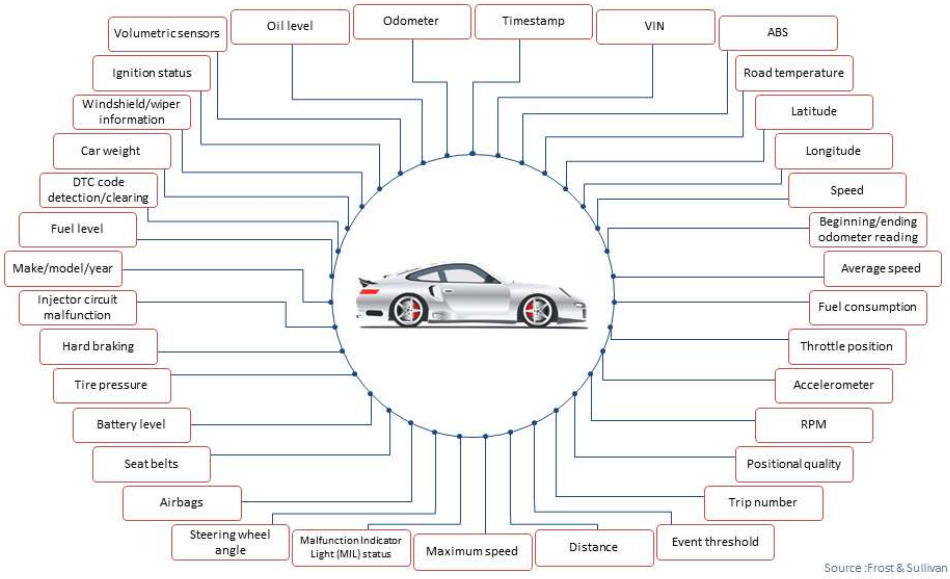
Data

Snapshot of Frequently Used Input Streams for Data Capture



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Data

Data

Data to Information

Automated Vehicles

Google spent **$60million**

Toyota, GM and Ford **$1billion****

Driverless car technology investment over the last 3 years is **$60billion***

*The Hill, Brookings Institution 5/22/18
** Washington Post 10/21/18

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Data

Data

Data to Information

INRIX

here

waze

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Data

Data

Data to Information

amazon.com **Recommended** for You

Amazon.com has new recommendations for you based on items you purchased or told us you own.

Google Apps Deciphered: Compute in the Cloud to Streamline Your Desktop

Google Apps Administrator Guide: A Private-Label Web Workspace

Googlepedia: The Ultimate Google Resource (3rd Edition)

Personalized information

For those 35 and younger,

80% want the car to understand their technology preference and predict their needs

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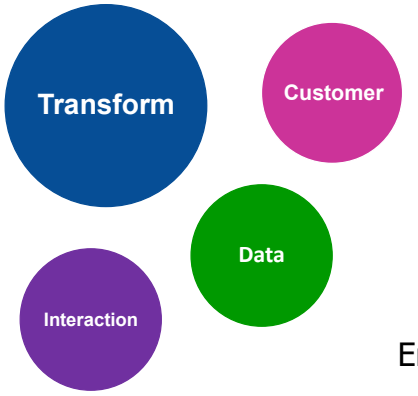

Connect the dots

Engage in **Digital Dialogs**

Engage on **Mobile** platforms and **Visually**

Provide **products/services online**

Leverage and **share data**

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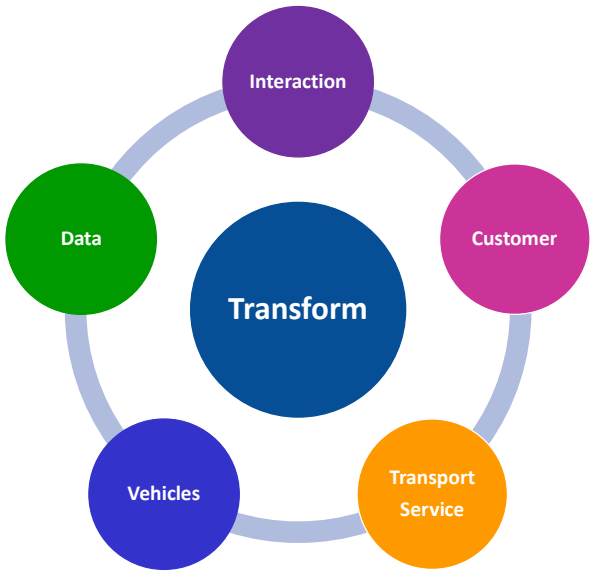

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Vehicles

Vehicles

Horsepower to Processing Power

First space shuttle had
500,000 lines of code

Ford projects that by 2020, vehicles will have
100 billion lines of code*

*Washington Post 1/16/18
Lisa Joy Rosner, Otonomo

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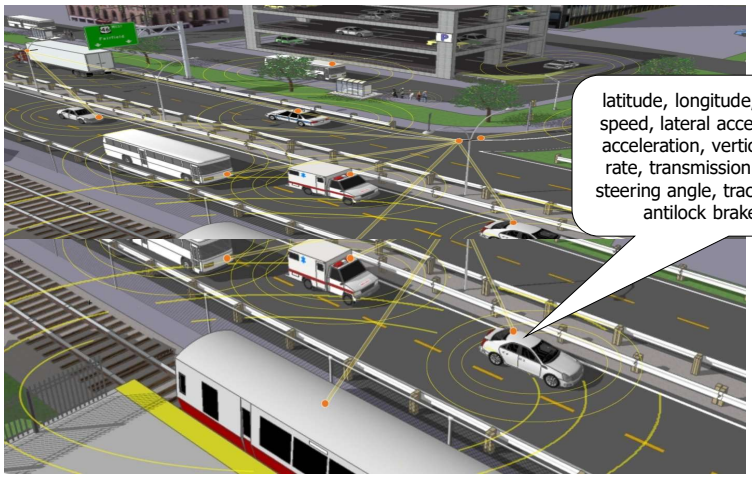
Vehicles

Vehicles

Horsepower to Processing Power
Connected Vehicles



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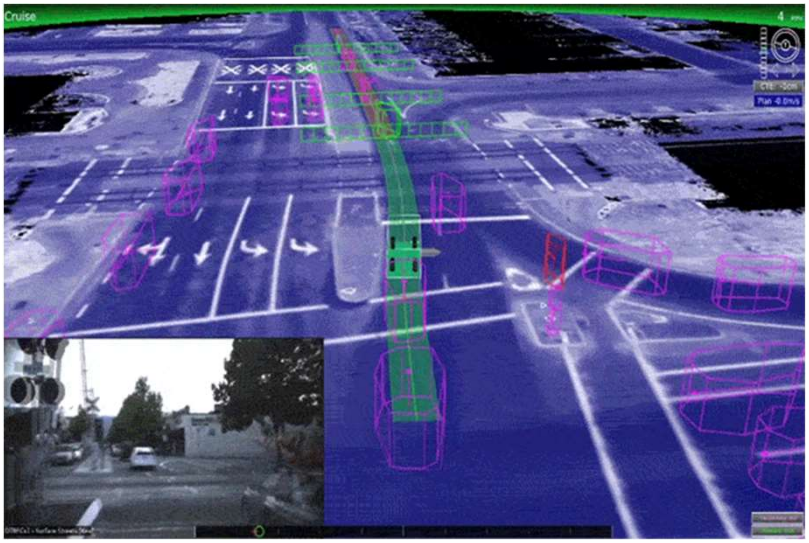
Vehicles

Vehicles

Horsepower to Processing Power

Automated Vehicles



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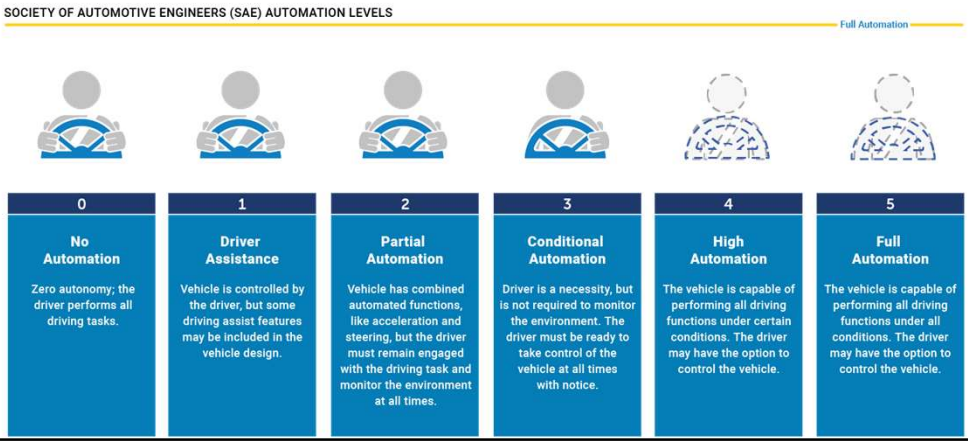
Vehicles

Vehicles

Horsepower to Processing Power

Federal Automated Vehicles Policy

Updated September 2017



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Vehicles

Vehicles

Horsepower to Processing Power

Automated Vehicles

By **2040**, AVs will be **95%** of new vehicles sold; **96.3 million** sold globally*

*Fortune 9/13/17

IBM predicts that **15%** of new cars sold by 2030 will be AVs#

#CNBC 10/1/19

57 companies are authorized to test AVs on California roads

30 states took up **78** proposals to regulate autonomous driving**

**Route Fifty 5/17/18

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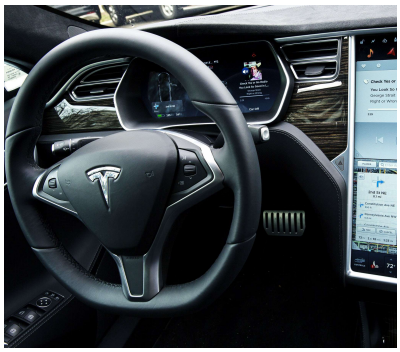
Vehicles

Vehicles

Horsepower to Processing Power

Automated Vehicles



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Vehicles

Vehicles

Horsepower to Processing Power

Automated Vehicles

61% of Americans are *not* inclined to ride in a self-driving car**

69% are concerned about sharing the road with AVs*

**Brookings Institution

*Advocates for Highway and Auto Safety

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Vehicles

Vehicles

Horsepower to Processing Power

Automated Vehicles

Widely available self-driving cars will take **"longer than you think."**

John Krafcik, Waymo

Slow down.
And shut up.

Washington Post 10/21/18

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Vehicles

Vehicles

Horsepower to Processing Power

Electric Vehicles

By **2019**, all new Volvos will be electric or hybrid**

By **2040,** majority of new car sales outside US will be **electric***

EV charging stations from **650,000** to **7 million by 2021**

**Washington Post 7/6/17 *Forbes 3/27/18

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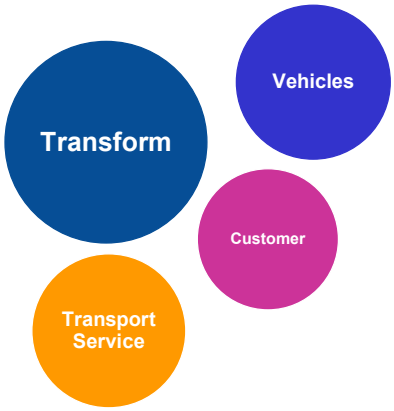

Connect the dots

ACES Vehicles

Autonomous
Connected
Electric
Shared

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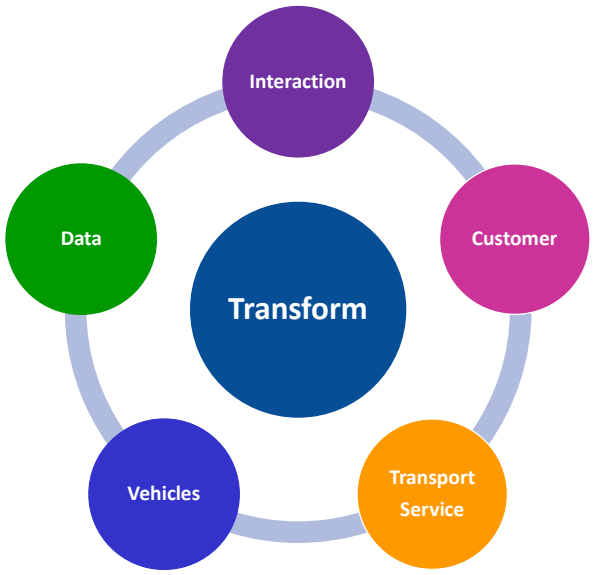
Transformation of Transportation



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Transport Service

Transport Service

From driving to a service

Uber

2009: Founded as "UberCab"
2010: The app was released
2012: Expanded internationally
2015: Reached $2.8 billion in total funding

As of May 28, 2015, the service was available in
58 countries and **300 cities worldwide**
Services **40 million riders/month worldwide**

Google invested **$238 million**

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Transport Service

Transport Service

From driving to a service

Mobility-as-a-Service (MaaS)

Uber

MAVEN

App-based ride services **tripled** between spring 2015 and now*

39% of young people say they can get around just fine without driving

*NYC Transit Study

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Transport Service

Transport Service

From driving to a service

Mobility-as-a-Service (MaaS)

GM

MAVEN

10,000 cars

9% stake in Lyft*

Launching **AV ride-hailing** service in **2019****

Business Insider 8/22/17
**Washington Post 12/2/17

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Transport Service

From driving to a service

Transform

60% of TNC users would have taken transit, walked or biked*

Uber

TNCs put **2.6 new vehicle miles** on the road for each mile of personal driving removed*

MAVEN

*The New Automobility: Lyft, Uber and the Future of American Cities

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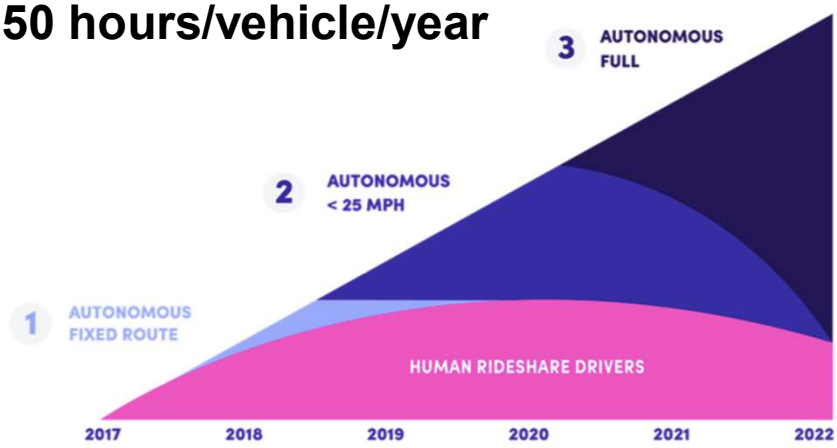
Transport Service

Transformation of Transportation

Americans drive 1.5 trillion miles/year
which is **250 hours/vehicle/year**



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Transformation of Transportation

Transform

Vehicles

Customer

Transport Service

Connect the dots

Mobility-as-a-Service

Most self-driving cars will be used as **MaaS**

MaaS deployment begins before **2020**

Reduce cost from **$4** /trip mile to **$0.50** /trip mile

IHS Automotive

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Transformation of Transportation

Transform

"With the power of AI and the rise of autonomous and connected vehicles, we have mobility technology that won't just incrementally improve the old system but can **completely disrupt it**…

It's a **total redesign of the surface transportation system** with humans and community at the center."

--Jim Hackett, CEO Ford

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Transformation of Transportation

Transform

Self-driving vehicles: **5-20** years

MaaS: **5-10** years

Connected vehicles: **now-30** years

Life span of new roadway, bridge, transit, parking garage: **10-40** years

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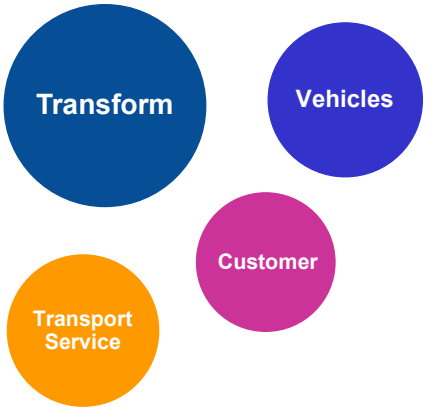
Transformation of Transportation



Connect the dots

Parking Implications

Average car sits idle **22 hours/day**

3-8 parking spaces/car in US*

Over **1 billion cars** in the **world** and **2 billion** parking spaces in **US**#

#East Valley Tribune *UC Berkley

Single shared AV could make **5** times as many trips**

**Eno Center

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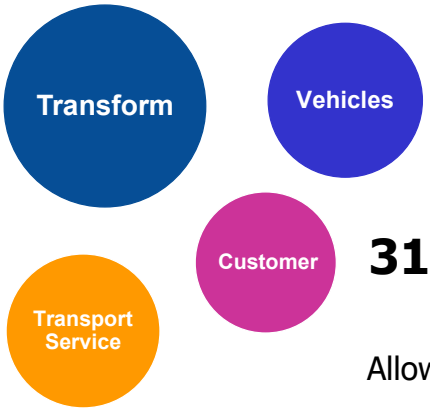

Connect the dots

Land Use

31% of CBD space of most (41%) major cities is parking

Allow cities to redevelop **50%** of current street parking#

#2016 National League of Cities report

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Transformation of Transportation

Transform

Curb Space

Curb space uses:

Parking
Deliveries
Vehicle charging
Bike-share
Smart meters
AV for MaaS
Pedestrians

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Transformation of Transportation

Transform

Connect the dots

Modeling & Design

Historic data (pre iPhone) to plan
20 years from now

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Transformation of Transportation

Transform

Connect the dots

Plan for flexibility

Only **6%** of city and regional transportation plans consider self-driving vehicles*

Only **3%** of transit plans consider ride-sharing companies like **Uber, Lyft**

* 2016 National League of Cities

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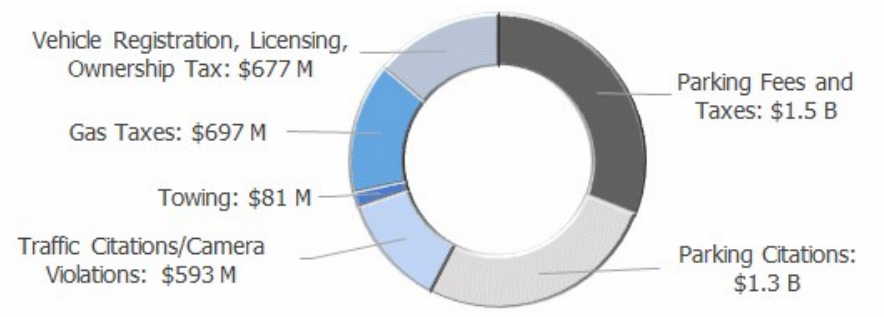
Transformation of Transportation

Transform

Revenue Impacts

Revenue shortfall of more than **$5 billion** in auto-related revenue

2016 National League of Cities



"Half of the revenue for transportation capacity & operations is based on a parking model that will be obsolete in a dozen years."
Rob Spillar, Austin, TX

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Transformation of Transportation

Connect the dots

What do we want?

High-occupancy vehicles

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Uber Eats

Connect the dots

What do we want?

Zero-occupancy vehicles

Transit Oriented Development

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Transformation of Transportation

Connect the dots

What do we want?

Zero-occupancy vehicles

Automated Oriented Development

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Up to **80% fewer** cars on the road*

Convergence of automation, electrification & shared mobility may result in **auto-induced exurb sprawl****

*Carlo Ratti, MIT Senseable City Lab
**Institute of Transportation Studies, UC Davis

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Transformation of Transportation

Transform

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Transformation of Transportation

Transform

Low Risk

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Transformation of Transportation

Transform

High Risk

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Transformation of Transportation

Transform

Connect the dots

Plan and design for flexibility

Build in **off ramps** in the planning and design process for large investments

Assess technology & other **trends**

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Transformation of Transportation

Transform

"It could turn out 100 different ways. We have to design & plan for flexibility."
Ann Arbor

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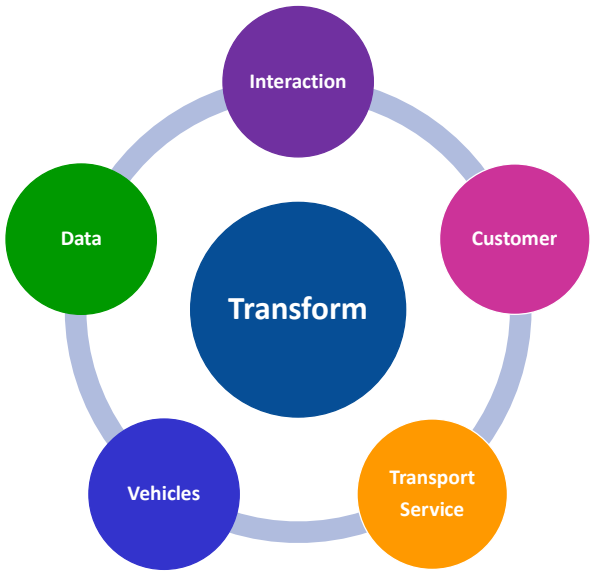
Transformation of Transportation



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